

Dispersant Application System for the U.S. Coast
Guard 32-Foot WPB (Waterways Patrol Boat)

Mason and Hanger-Silas Mason Co., Inc.
Leonardo, NJ

Prepared for

Municipal Environmental Research Lab.
Cincinnati, OH

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**DISPERSANT APPLICATION SYSTEM FOR THE
U.S. COAST GUARD 32-FOOT WPB**

by

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Contract No. 68-03-2642

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16. ABSTRACT This illustrated report describes details of the fabrication, assembly, and operation of a lightweight, easily assembled system for dispensing chemical dispersants on oil spills. This system is designed to be fitted onto the aft deck of the U.S. Coast Guard 32-foot waterways patrol boat (WPB), a vessel stationed in many areas where oils are commonly transferred or transported. This report is intended to provide those detailed instructions necessary to the man actually doing the fabrication, assembly, or operation. Sixteen illustrations and parts lists are also provided.		
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FOREWORD

The U.S. Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimonies to the deterioration of our natural environment. The complexity of that environment and the interplay of its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution; it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems to prevent, treat, and manage wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, to preserve and treat public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research and provides a most vital communications link between the researcher and the user community.

This illustrated report describes details of the fabrication, assembly, and operation of a lightweight, easily assembled system for dispensing chemical dispersants on oil spills. This system is designed to be fitted onto the aft deck of the U.S. Coast Guard 32-foot waterways patrol boat. This report will be of interest to those concerned with fabricating or operating the system, and to those interested in the hardware associated with dispersant application systems. The work was done by Mason & Hanger-Silas Mason Co., Inc. under Contract No. 68-03-2642, as partial completion of Job Order 57.

Francis T. Mayo, Director
Municipal Environmental Research Laboratory
Cincinnati

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ABSTRACT

This illustrated report describes details of the fabrication, assembly, and operation of a lightweight, easily assembled system for dispensing chemical dispersants on oil spills. This system is designed to be fitted onto the aft deck of the U.S. Coast Guard 32-foot waterways patrol boat (WPB), a vessel stationed in many areas where oils are commonly transferred or transported.

This report is intended to provide those detailed instructions necessary to the man actually doing the fabrication, assembly, or operation. Fourteen illustrations and parts lists are also provided.

This report was submitted in fulfillment of Contract No. 68-03-2642, Job Order No. 57 by Mason & Hanger-Silas Mason Co., Inc., under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from December 1979 to January 1981, and the work was completed as of February 1981.

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CONTENTS

Foreword	iii
Abstract	iv
Figures	vi
Tables	vi
List of Abbreviations	vii
List of Conversions	viii
Acknowledgments	ix
1. Introduction	1
2. Fabrication	3
Support Frames	3
Spray Booms	3
Eductor System	3
3. Installation	13
Support Frames	13
Spray Booms	13
Eductor System	13
4. Dispersant Application	18

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FIGURES

<u>Number</u>		<u>Page</u>
1	Dispersant application system mounted on USCG 32-foot WPB	2
2	Drawing of support frame	4
3	Detailed drawing of dispersant spray boom	5
4	Detailed drawing of dispersant eductor system	6
5	Dispersant application system support frame	11
6	Interfacing of support frame to WPB deck	11
7	Drawing of spray boom and support frame	12
8	Port spray boom in operating position	14
9	Spray booms in traveling mode	15
10	Vertical water main on the 32-foot WPB	17
11	Fire hose attachment to port spray boom	17
12	Starboard fore stay connection	19
13	Port aft stay connection	19
14	Starboard spray boom in operation	20

TABLES

1	Parts List for Spray Boom	8
2	Parts List for Support Frame	9
3	Parts List for Eductor System	10
4	Dispersant Dosage Chart	21

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LIST OF ABBREVIATIONS

FPT	--female pipe thread
GPA	--gallons per acre
GPM	--gallons per minute
IPT	--iron pipe thread
kt	--knot
MPT	--male pipe thread
NPT	--national pipe thread
NST	--national standard thread

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LIST OF CONVERSIONS

METRIC TO ENGLISH

To convert from	to	Multiply by
Celsius	degree Fahrenheit	$t_F = (t_C - 32)/1.8$
joule	erg	$1.000 \text{ E}+07$
joule	foot-pound-force	$7.374 \text{ E}-01$
kilogram	pound-mass (lbm avoird)	$2.205 \text{ E}+00$
meter	foot	$3.281 \text{ E}+00$
meter ²	inch ²	$3.937 \text{ E}+01$
meter ²	foot ²	$1.076 \text{ E}+01$
meter ³	inch ³	$1.549 \text{ E}+03$
meter ³	gallon (U.S. liquid)	$2.642 \text{ E}+02$
meter	liter	$1.000 \text{ E}+03$
meter/second	foot/minute	$1.969 \text{ E}+02$
meter/second	knot	$1.944 \text{ E}+00$
meter ² /second	centistoke	$1.000 \text{ E}+06$
meter ³ /second	foot ³ /minute	$2.119 \text{ E}+03$
meter ³ /second	gallon (U.S. liquid)/minute	$1.587 \text{ E}+04$
newton	pound-force (lbf avoird)	$2.248 \text{ E}-01$
watt	horsepower (550 ft lbf/s)	$1.341 \text{ E}-03$

ENGLISH TO METRIC

centistoke	meter ² /second	$1.000 \text{ E}-06$
degree Fahrenheit	Celsius	$t_C = (t_F - 32)/1.8$
erg	joule	$1.000 \text{ E}-07$
foot ²	meter ²	$3.048 \text{ E}-01$
foot ²	meter ²	$9.290 \text{ E}-02$
foot/minute	meter/second	$5.080 \text{ E}-03$
foot ³ /minute	meter ³ /second	$4.719 \text{ E}-04$
foot-pound-force	joule	$1.356 \text{ E}+00$
gallon (U.S. liquid)	meter ³	$3.785 \text{ E}-03$
gallon (U.S. liquid)/minute	meter ³ /second	$6.309 \text{ E}-05$
horsepower (550 ft lbf/s)	watt	$7.457 \text{ E}+02$
inch ²	meter ²	$2.540 \text{ E}-02$
inch ²	meter ²	$6.452 \text{ E}-04$
knot (international)	meter/second	$5.144 \text{ E}-01$
liter	meter ³	$1.000 \text{ E}-03$
pound force (lbf avoird)	newton	$4.448 \text{ E}+00$
pound-mass (lbm avoird)	kilogram	$4.535 \text{ E}-01$
pound/foot ²	pascal	$4.788 \text{ E}+01$

ACKNOWLEDGMENTS

The authors wish to acknowledge Mr. Leo T. McCarthy, Jr. of the U.S. Environmental Protection Agency who provided funding for this project. They further wish to acknowledge Lt. Thomas Meisenzahl, of the U.S. Coast Guard Station, New York (Governor's Island), for easing the interface with the USCG, and for making available the boats as required during the development.

SECTION 1

INTRODUCTION

The U.S. EPA in conjunction with the U.S. Coast Guard (USCG), has developed a lightweight, easily assembled system to fit on the USCG 32-foot¹ waterways patrol boat WPB. The system is assembled on the aft deck directly behind the cabin (Figure 1). It can be readily installed on the 32-ft WPB by three men in two working hours. It includes two spray booms supported by a rectangular frame work. The spray booms are supplied water from the boat's fire fighting system, and chemical dispersant is fed into the water by an eductor. Support for the framework of the system is provided by the deck cups which ordinarily support stanchions for the hand rail. The removal of the stanchions also necessitates the removal of Search and Rescue (SAR) gear. SAR operations will therefore be impaired. Two engine compartment hatches are covered by the framework, but access is still possible. After drums of dispersant have been placed onboard, access to the stern hatches will be difficult, if not impossible.

This report covers the construction procedures, the necessary materials for fabrication, assembly of the system, interfacing with the WPB, and use of the system. It does not address prior approval procedures legally required for the use of dispersants, nor does it list preferred dispersants or commercial dispersant suppliers.

The system could readily be adapted for use on other vessels of opportunity. The only limiting conditions are the ability to provide sufficient height for the spray booms and structural integrity. The system needs an adequate supply of water from an onboard source. For example, the end sections of the support frames developed for the 32-ft WPB could be lashed to the side handrails of most vessels with fore and aft stays secured as convenient.

¹ English units are used throughout this report. It is felt that the report is to be primarily a working document rather than a research summary and that the user will be more familiar with the traditional English units. A conversion table is given on page viii.

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Figure 1. Dispersant application system mounted on USCG 32-foot WPB.

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EPA Form 2050-4 (4-80)

USE ONLY THE EPA FORM 2050-4

TABLE 1

TYPING GUIDE SHEET

SECTION 2

FABRICATION

SUPPORT FRAMES

The assembly is easily fabricated according to dimensions as given in the parts list (Tables 1 through 3). The frame components (#'s 8, 11, and 17) are welded into units on the port and starboard sides. The horizontal cross-pieces (#20) of the support frame (see Figure 2) are left separate for easier assembly on the WPB. The two stern vertical pieces (#17) need two $\frac{1}{4}$ -in holes drilled in them, one approximately two inches from the top for an eye nut and bolt and the second approximately three feet six inches (3'6") from the bottom to serve as a stay for the $1\frac{1}{2}$ -in tees. Once the tees have been machined and placed over the uprights, weld the tabs (#14, 16 and 18) to each of the four uprights. Attach structural tees as shown in Figure 3, Detail B and weld.

The spray boom supports on the frame (Detail B) are constructed by machining the run of a $1\frac{1}{2}$ " tee (#6) (nuts to have an I.D. of $1.920"-0.001"+0.020"$) such that they will fit over the $1\frac{1}{2}$ " pipe and be free to slide and rotate without excessive play. Thread a $1\frac{1}{2}$ " close nipple (#5) into the bull of the tee, and thread a $1\frac{1}{2}$ "x2" bell reducer (#4) into the nipple. Join the special angle (#2) to the tee using 2" nipples (#1 and #3). This special angle is constructed of steel for protection during handling and because of the strain it takes during operation. To make each angle (#2), weld two unions to the desired angle (about 8 degrees for a 32' WPB).

SPRAY BOOMS

Drill three holes in the aluminum pipe (#21) to the size specified by the spray nozzle manufacturer. Nozzles for the WPB were chosen to be $\frac{3}{4}$ " but the final selection must be based on flow rate, spray boom height, and desired coverage width. Weld an aluminum coupling that matches the nozzles onto the pipe at the drilled holes. Weld three 2"x2"x $\frac{1}{4}$ " pieces of aluminum flatstock (#16) with $\frac{5}{8}$ " diameter drilled holes to the top, fore, and aft sides of the boom three feet from the end. Screw end caps (#22) onto outboard boom ends and two inch tees (#23) onto inboard boom ends. Screw a $1\frac{1}{2}$ "x2" reducing bushing (#24) on one end of the tee (#23) and the spray boom pipe onto the other end. Attach an adapter (#26) male 2" NPT to male $1\frac{1}{2}$ " NST, to make the connection from the fire hose to the boom. Attach a 6" length of $1\frac{1}{2}$ " pipe (#25) to the reducing bushing (#24). The opposite end of the six-inch pipe length has had a plate welded to the end to block the flow diluted dispersant.

EDUCTOR SYSTEM

The eductor system (Figure 4) transports dispersant from drums on the WPB's aft deck to the spray booms. The suction pipe with the flowmeter assembly is screwed into the drum. To fabricate the suction pipe, fit a 32" length of $1\frac{1}{2}$ " pipe (#51) with a

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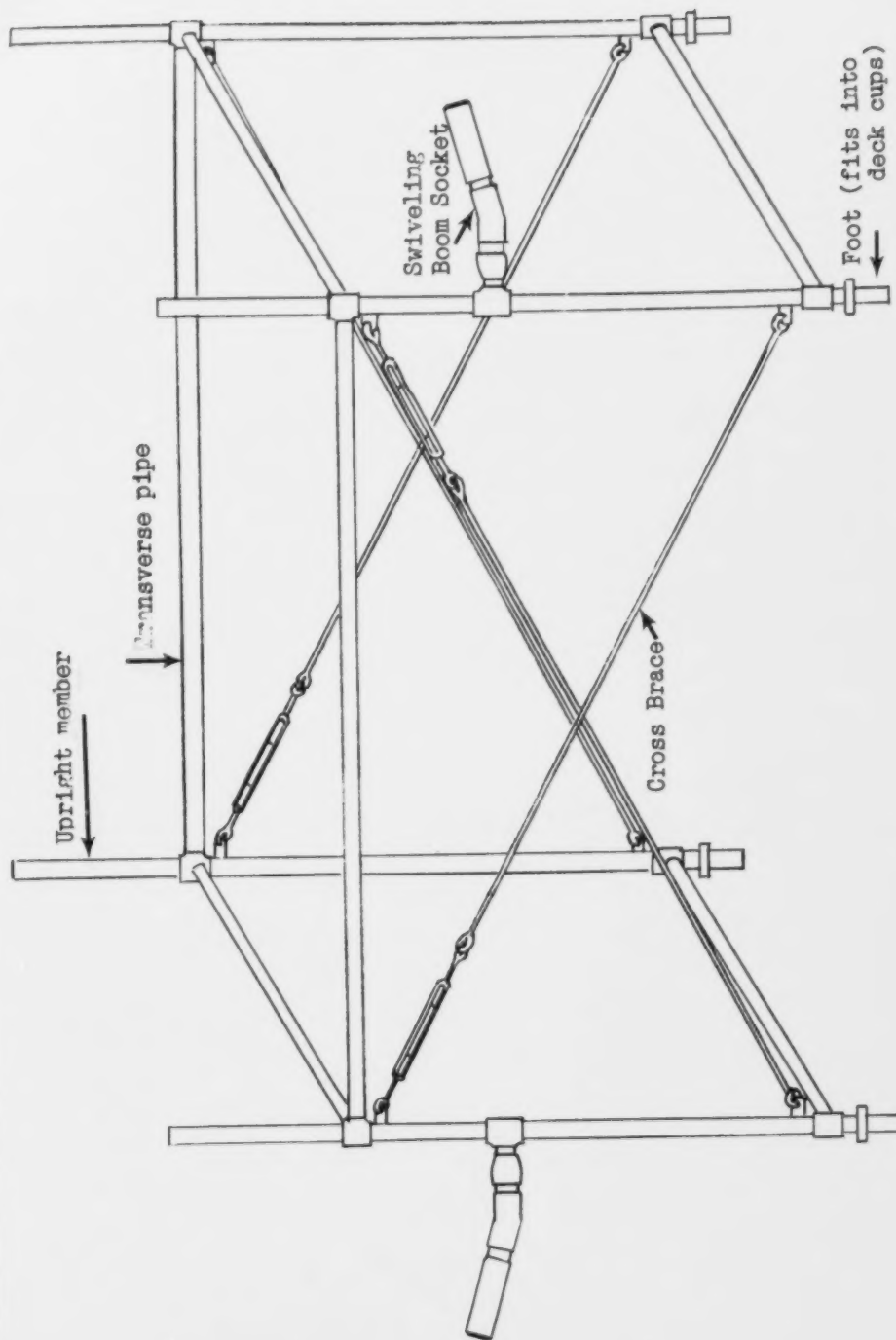


Figure 2. Drawing of dispersant application system support frame.

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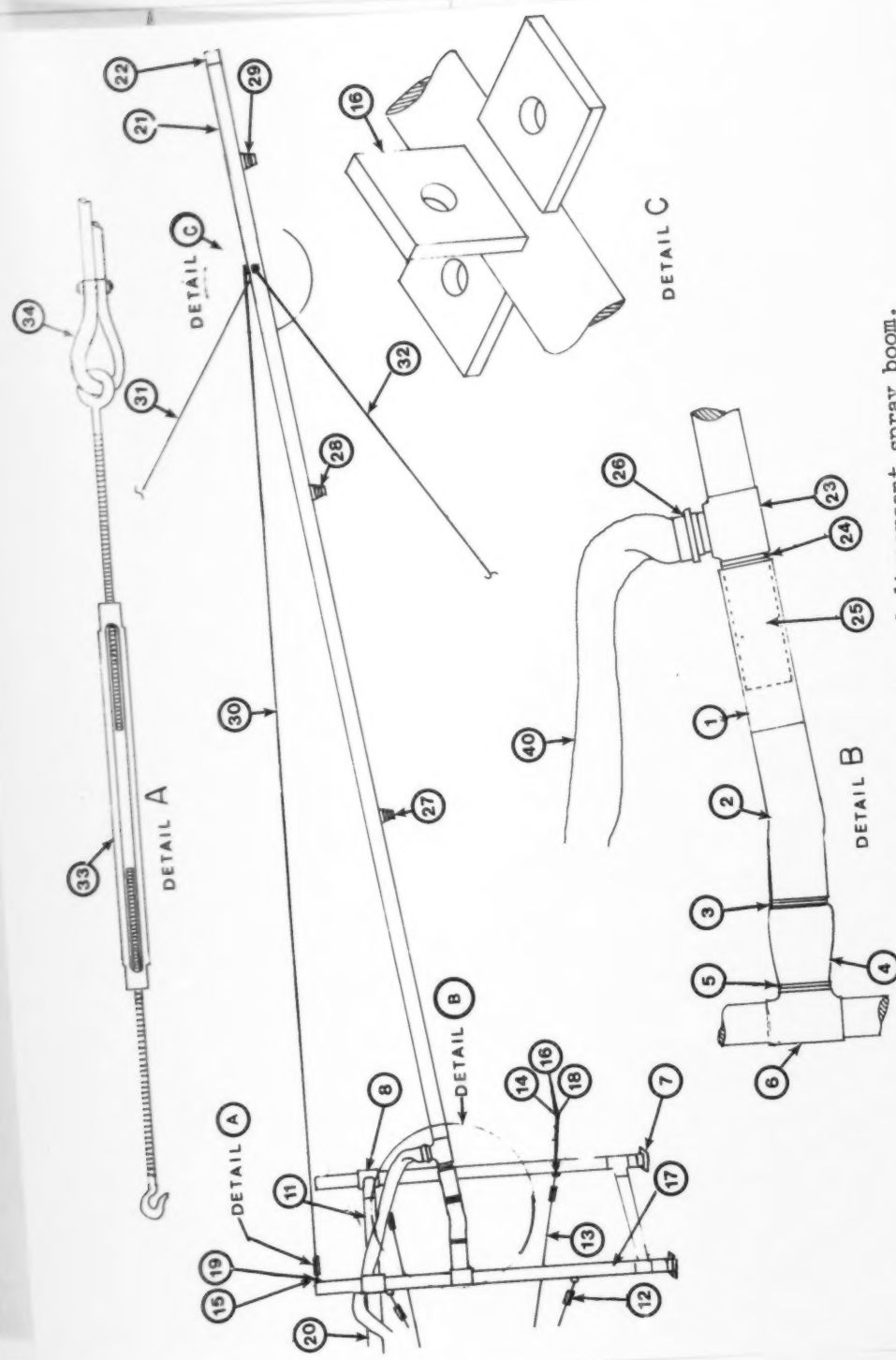


Figure 3. Detailed drawing of dispersant spray boom.

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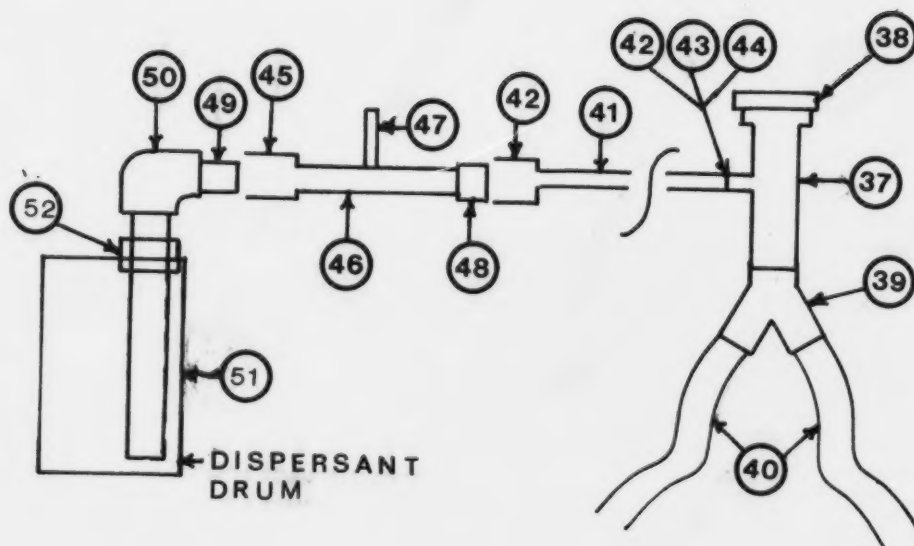


Figure 4. Detailed drawing of dispersant eductor system.

1½" x 2" reducing bushing (#52) which has been machined to slide over the 1½" pipe. Screw the bushing into a 55-gallon drum and slide the suction pipe to the bottom of the drum through the bushing. Raise the suction pipe ½" and weld to the bushing. Attach an elbow (#50) and camlock (#49) to the pipe end sticking out of the barrel, completing suction pipe assembly. The flowmeter assembly consist of a flowmeter (#47) attached to a 1½" pipe (#46) through a 5/8" hole. The camlocks (#45 and 48) are attached to the appropriate ends to mate with the suction pipe. Attach a length of 1" hose (#41) with a 1" x 1½" reducing bushing (#42) and a camlock (#45) to the flowmeter assembly. Attach the second end of the 1" hose (#41) to the eductor (#37). Attach the eductor inlet to the fire water standpipe outside the cabin of the 32' WPB using appropriate adapters (#38). Place a wye valve (#39) and 1½" fire hoses (#40) between the eductor and the spray booms.

When all of the components of the entire system have been constructed and fit to the WPB, the segments should be color coded for future quick recognition of port (red) and starboard (green) units. The color coding is easily accomplished with two cans of spray paint marking pieces at the connection to the mating units.

When the paint dries, disassemble the dispersant application sytem. The stays will have been fine-tuned to fit the vessel. The port and starboard stays will not necessarily be exactly the same length, therefore, the wire rope stays should be secured to the corresponding spray booms with electrician's tape.

TABLE 1. PARTS LIST FOR SUPPORT FRAME

QUANTITY	DESCRIPTION	PART #
SUPPORT FRAME (2 ea.) Welded aluminum side frames consisting of Parts 1 through 11:		
2	2"x6" galvanized steel nipples*	1
4	2" galvanized steel couplings, machined and welded to form an 80° angle	2
2	2" galvanized steel close nipple	3
2	1½"x2" galvanized steel bell reducer	4
2	1½" galvanized steel close nipple	5
2	1½" galvanized steel tee machined to slide over 1½" pipe	6
4	1½" aluminum stanchion base	7
12	1½" aluminum stanchion tee	8, 9, 10
4	1½"x33" aluminum pipe	11
4	7" galvanized steel turnbuckles	12
4	1/8"x8' steel, wire rope	13
8	1/8" wire rope thimble-clamps	14
2	½" eyenuts	15
8	2"x2"x¼" aluminum plates with 5/16" hole	16
4	1½"x7' aluminum pipe	17
8	¾" galvanized steel shackles	18
2	½"x3" galvanized bolts with nuts	19
2	1½"x92½" aluminum, schedule 40 pipe	20

*Note: All pipe parts in above table are schedule 40.

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TABLE 2. PARTS LIST FOR SPRAY BOOM

QUANTITY	DESCRIPTION	PART #
SPRAY BOOM (2 ea. welded) consisting of the following parts:		
2	2"x20' aluminum pipes*	21
2	2" aluminum pipe cap	22
2	2" aluminum pipe tee	23
2	1½"x2" steel reducing bushings	24
2	1½"x6" steel pipe nipples with one end welded shut	25
2	1½" NST x 2" NPT fire hose adapters	26
6	¾" aluminum couplings	27
6	¾" axial flow straighteners	28
6	¾" spray nozzles	29
2	¾"x18' wire rope top stays	30
2	¾"x 40' wire rope forward stays	31
2	¾"x 40' wire rope aft stays	32
16	12" galvanized steel turnbuckles	33
6	¾" wire rope thimble-clamps	34
6	3/8" galvanized shackles	35
4	5/8" galvanized shackles	36

*Note: All pipe parts in above table are schedule 40.

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TABLE 3. PARTS LIST FOR EDUCTOR SYSTEM

QUANTITY	DESCRIPTION	PART #
EDUCTOR SYSTEM (1 each) using the following parts:		
1	2½" NST x 1" NPT x 2½" NST eductor *	37
1	2½" NST x 2½" IPT adapter	38
1	2½" NST x 1½" NST Wye valve	39
2	1½" NST x 10' double jacketed fire hoses	40
1	1"x15' rubber hose	41
2	1" hose fittings with 1"x1½" reducing bushing	42
1	1" galvanized union	43
2	1" galvanized close nipple	44
2	1½" female x 1½" FPT camlock	45
1	1½"x21" galvanized steel pipe with 5/8" hole as shown	46
1	0-40 gpm flowmeter	47
1	1½" male x 1½" FPT camlock	48
1	1½" male x 1½" MPT camlock	49
1	1½" galvanized steel elbow	50
1	1½"x32" galvanized steel pipe	51
1	1½"x2" galvanized steel reducing bushing	52

*Note: All pipe parts in above table are schedule 40.

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Figure 5. Dispersant application system support frame.



Figure 6. Interfacing of support frame to WPB deck.

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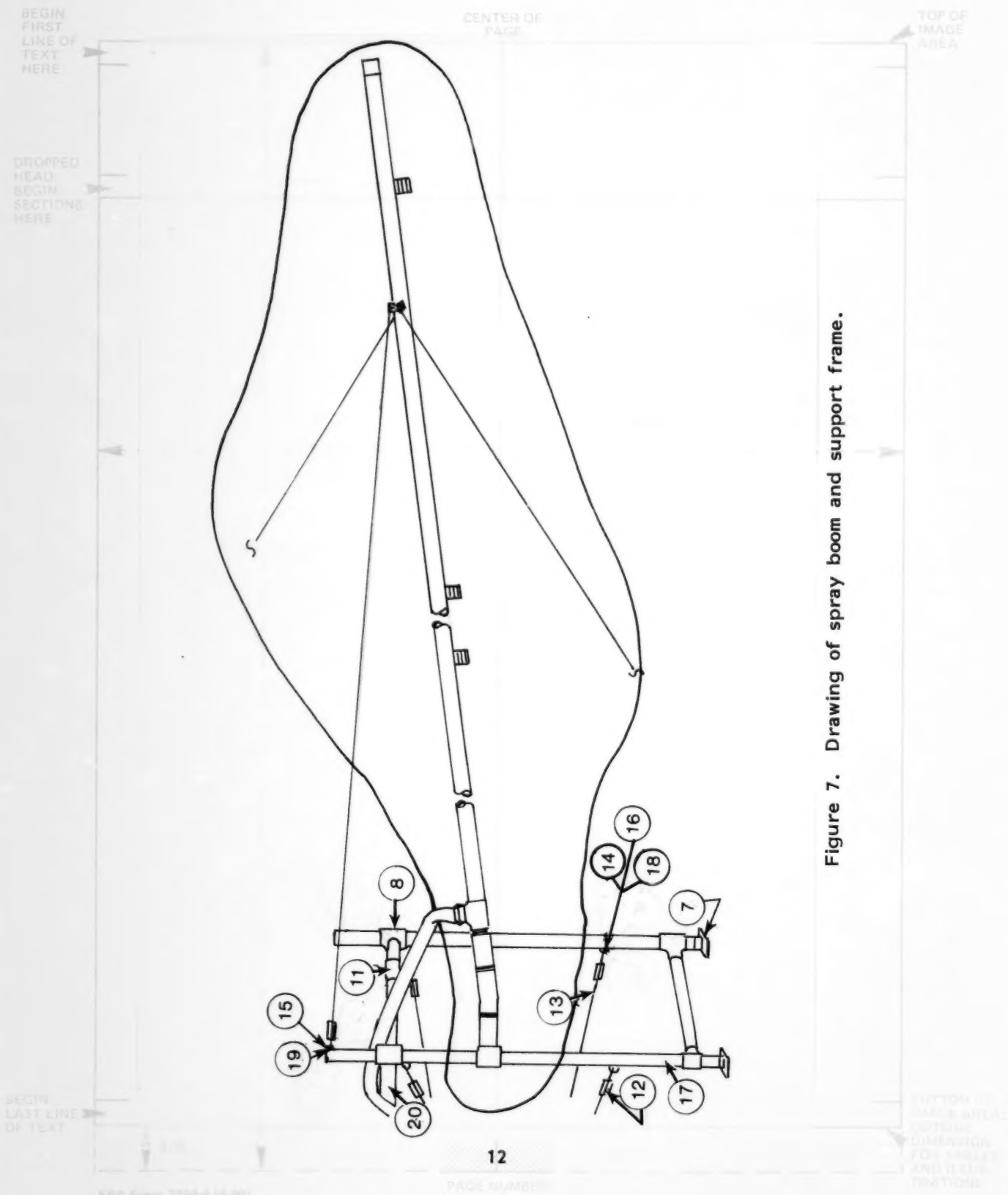


Figure 7. Drawing of spray boom and support frame.

SECTION 3
INSTALLATION

SUPPORT FRAME

The support frame is shown in Figures 5 and 6.

1. Remove two port and starboard hand rails nearest the cabin from their deck sockets.
2. Insert the port (red) and starboard (green) support end-frames into the hand rail cups (Figure 6).
3. Place the two transverse pipes between each end-frame. Ends of the transverse pipes fit into sockets in each end-frame. An allen wrench is used to secure the pipes into the fittings.
4. Attach four 1/8" wire rope stays between end-frames and tighten turnbuckles.

SPRAY BOOMS

The boom is shown in Figures 7, 8, and 9.

1. Remove tape securing wire rope stays to spray booms.
2. Attach top stay of port boom (red) to eye-nut at top of port suport end-frame (Figure 8).
3. Place 1½"x6" pipe stub (on end of boom with fire hose inlet) into socket below where top stay is connected. This requires at least two and preferably three people to support boom. Care is also required after stub pipe is in socket, as boom will swing in response to boat movement.
4. Rotate boom until spray nozzle points towards water.
5. Swing boom until it points aft over the stern (Figure 9). Secure fore and aft stays to support frame so boom cannot swing uncontrolled.
6. Repeat Steps 2 through 5 with starboard (green) spray boom.

EDUCTOR SYSTEM

The eductor system is shown in Figures 10 and 11.

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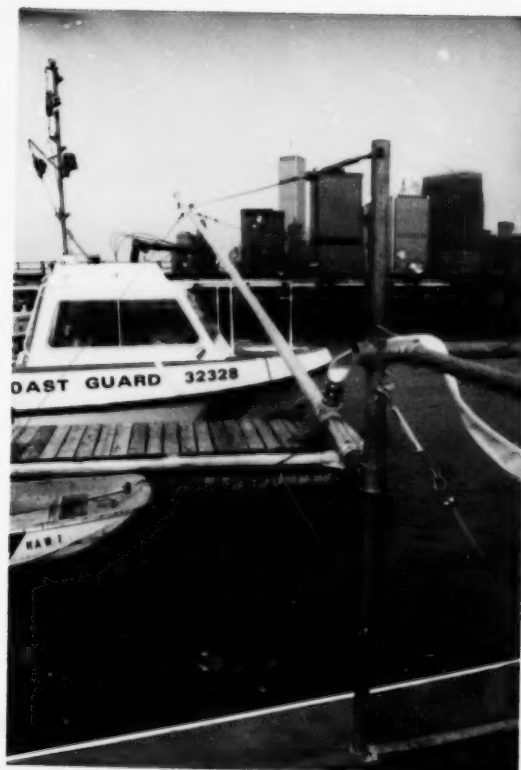


Figure 8. Port spray boom in operating position.

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Figure 9. Spray booms in traveling mode.

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1. Attach 2½"x2½" adapter to vertical water main outside cabin near door, if needed (Figure 10).
2. Attach 2½"x1"x2½" eductor to adapter.
3. Attach 2½"x1½" wye valve to eductor.
4. Attach one fire hose to each 1½" outlet on the wye valve.
5. Attach the opposite fire hose ends to the port and starboard boom inlet fittings (Figure 11).
6. Attach the 1", black-rubber hose to the 1½" eductor fitting. This connection is made using the 1" union fittings on the eductor and hose.
7. Place dispersant drums on boat and secure.
8. Open 2" drum hole on the first dispersant drum and insert 1½" suction pipe. Screw into drum hole until hand tight. Caution: most dispersants are caustics—wear appropriate protective clothing.
9. Attach flowmeter assembly to drum suction pipe using quick-disconnect fittings provided.
10. Attach 1½" black-rubber eductor hose to flowmeter assembly using quick-disconnect fittings provided.

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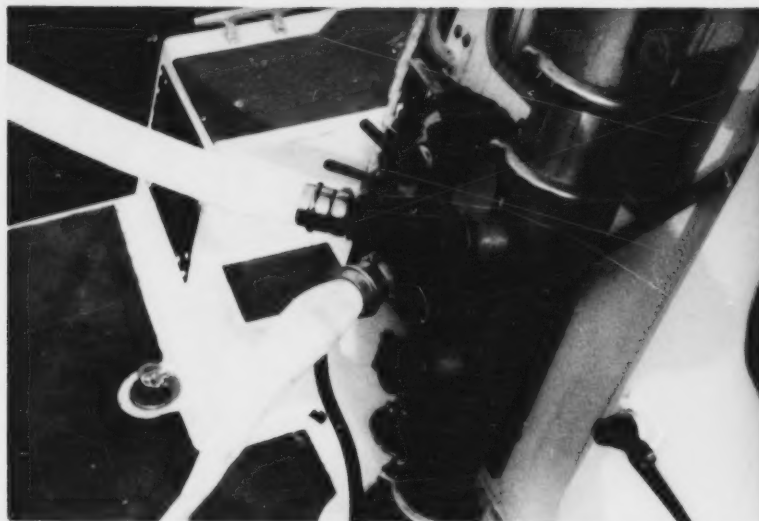


Figure 10. Vertical water main on the 32-foot WPB.



Figure 11. Fire hose attachment to port spray boom.

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SECTION 4

DISPERSANT APPLICATION

Upon arrival at the designated site for the application of dispersant, use fore-stay (#21) to swing boom to operating position. Attach fore-stay turnbuckle to the clevis at the fore chain plate (Figure 12). Insert the aft stay into the aft chain plate clevis (Figure 13) and adjust turnbuckles to bring boom perpendicular to the side of the vessel. Repeat for opposite boom. Make stays taut, but not excessively tight.

Start the fire-fighting pump and wait for steady flow to develop from the spray nozzles (Figure 14). Select a dispersant flowrate for the desired vessel speed and dispersant dosage as shown in Table 4. Set the eductor to the desired concentration by reading the flow from the dispersant drum meter.

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Figure 12. Starboard fore stay connection.

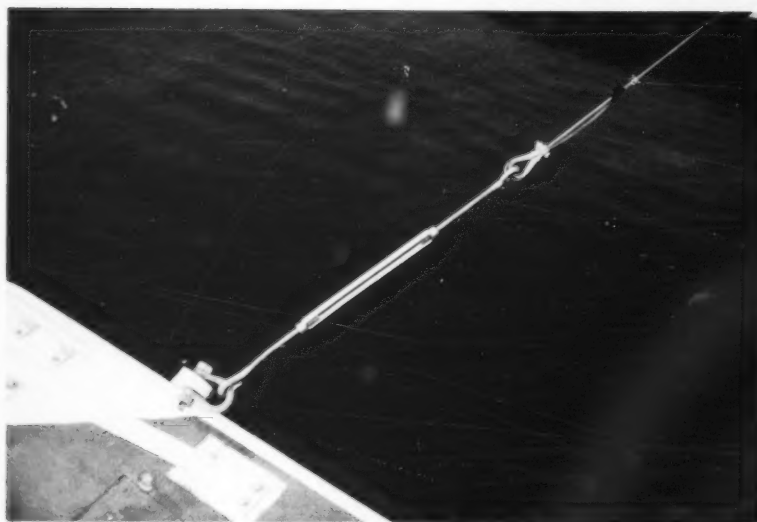


Figure 13. Port aft stay connection.

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Figure 14. Starboard spray boom in operation.

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TABLE 4. DISPERSANT DOSAGE CHART*

<u>Dispersant GPM reading necessary to disperse</u> <u>(X) Gallons/Acre of Oil</u>						
Vessel speed (kts)	Acres/min	3 GPA	5 GPA	7 GPA	10 GPA	15 GPA
1	0.11	0.3	0.6	0.8	1.1	1.7
2	0.22	0.7	1.1	1.5	2.2	3.3
3	0.33	1.0	1.7	2.3	3.3	5.0
4	0.45	1.4	2.3	3.2	4.5	6.8
5	0.56	1.7	2.8	3.9	5.6	8.4
6	0.67	2.0	3.4	4.7	6.7	10.1
7	0.78	2.3	3.9	5.5	7.8	11.7
8	0.89	2.7	4.5	6.2	8.9	13.4
9	1.00	3.0	5.0	7.0	10.0	15.0
10	1.11	3.3	5.6	7.8	11.1	16.7
11	1.23	3.7	6.2	8.6	12.3	18.5
12	1.34	4.0	6.7	9.4	13.4	20.1
13	1.45	4.4	7.3	10.2	14.5	21.8
14	1.56	4.7	7.8	10.9	15.6	23.4
15	1.67	5.0	8.4	11.7	16.7	25.1
16	1.78	5.3	8.9	12.5	17.8	26.7
17	1.90	5.7	9.5	13.3	19.0	28.5
18	2.01	6.0	10.1	14.1	20.1	30.2
19	2.12	6.4	10.6	14.8	21.2	31.8
20	2.23	6.7	11.2	15.6	22.3	33.5

*Dispersant application concentrations should be determined by the on-scene coordinator.

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